ANALYSIS

OF

THE APPLE.

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ANALYSIS OF THE APPLE.

This examination was entered into with the view of throwing some light upon the composition of the apple. To determine whether or not, it contained a sufficient percentage of nutritious matter to render it profitable as food for stock. That it has been used with a good degree of success, in many instances, for several years, is well known; but it is by no means generally acceded, that the apple is as nutritious as it actually is. Those who have had some experience in feeding good varieties, will find in the following analysis the reason of their favorable opinion of this valuable product of the farmer;—valuable, because if properly managed, the crop is sure, large, rich, and attended with less labor and expense than almost any other.

It was the intention to have analyzed several varieties of sweet apples, but owing to the lateness of the season before the examination was commenced, and the scarcity of these varieties, I was unable to obtain any, except the Tolman Sweeting.

PERCENTAGE OF WATER, DRY MATTER AND ASH, IN THE

	Pulp of the Swaar.	Skin or epidermis of the Swaar.
Percentage of water,.....	84.75	61.20
" dry matter,.....	15.25	38.80
" ash, ...	0.26	0.72
" ash calc. on the dry matter,..	1.705	1.856

PERCENTAGE OF WATER AND DRY MATTER IN THE

	Tolman Sweeting.	Roxbury Russet.	Kilham Hill.	English Russet.	R. Island Greening.
Percentage of water, ...	81.52	81.35	86.31	79.21	82.85
" dry matter,	18.48	18.65	13.69	20.79	17.15

The above results were obtained the first of March. The percentage of water in the six varieties examined ranges from 79.21 to 86.31 per cent. The Kilham Hill contains most, the Swaar stands next, the Greening third, and the English Russet has the least. The percentage mean from the six results is 82.664.

The percentage of inorganic matter in the apple is small, not much exceeding that of the richer grains. Like the ash of wheat and corn, it is obtained free from coal with some difficulty, on account of its fusing at a low red heat.

COMPOSITION OF THE ASH OF THE

	Swaar.		*Kilham Hill.*	
	With carbonic acid.	Without carbonic acid.	With carbonic acid.	Without carbonic acid.
Carbonic acid, ...	17.62	.....	16.17	.....
Silica,.....	1.43	1.750	1.34	1.693
Phosphate of iron,....	1.82	2.227	1.52	1.838
Phosphoric acid,.....	11.51	14.083	11.51	13.922
Lime,.....	4.05	4.956	2.48	2.999
Magnesia,.....	1.46	1.786	1.14	1.379
Potash, ...	34.34	42.016	29.62	35.821
Soda,.....	15.77	19.295	21.40	25.826
Chlorine,.....	1.71	2.092	1.93	2.334
Sulphuric acid,.....	5.44	6.656	6.52	7.898
Organic matter thrown down by nitrate of sil.	4.20	5.139	5.20	6.290
	99.35	100.000	98.84	100.000

COMPOSITION OF THE ASH OF THE

	Roxbury Russet,		*English Russet.*		*R. I. Greening.*	
	With carbonic acid.	Without carbonic acid.	With carbonic acid.	Without carbonic acid.	With carbonic acid.	Without carbonic acid.
Carbonic acid,....	14.11	.....	10.12	.....	18.03	.....
Silica, ...	1.95	2.278	0.94	1.051	1.15	1.412
Phosphate of iron,	1.34	1.564	0.96	1.062	1.04	1.277
Phosphoric acid,..	13.81	15.057	9.94	11.110	9.49	11.664
Lime, ...	4.16	4.857	2.92	3.263	3.60	4.421
Magnesia, ...	1.63	1.903	0.97	1.068	1.80	2.211
Potash,.....	29.51	34.958	34.27	38.323	31.31	38.440
Soda, ...	21.13	25.173	27.20	30.408	18.55	22.781
Chlorine, ...	1.97	2.300	1.65	1.848	1.85	2.272
Sulphuric acid, ...	5.84	6.889	5.98	6.684	6.53	8.019
Organic matter thrown down by nitrate of silver,	4.30	5.021	4.64	5.187	6.11	7.503
	99.75	100.000	99.59	100.000	99.46	100.000

The analyses are inserted both with and without the carbonic acid. They were calculated without it in order to show the real composition of the inorganic matter of the fruit. The carbonic acid is formed during the combustion of the organic matter, and hence cannot be regarded as a constituent part of the apple, except in very minute quantity.

In silica, the apple is by no means rich, containing in the varieties examined from about one to 2.3 per cent. The mean percentage of the five results is 1.637. The phosphate of iron ranges from about one to 2.2 per cent.; the phosphoric acid from 11 to 15 per cent.; the lime

from about 3 to 5 per cent.; the magnesia from about one to 2.2 per cent.; the potash from about 35 to 42 per cent.; the soda from 19.3 per cent. to 30.4 per cent.; the chlorine from 1.85 to 2.33 per cent., and the sulphuric acid from 6.66 to 8.02 per cent.

The percentage of ash in the apple is small, yet rich in phosphoric and sulphuric acids, potash and soda. 100 lbs. of apple ashes, deprived of carbonic acid, contain, according to the mean of the foregoing results, about 13 lbs. of phosphoric acid, 7 lbs. of sulphuric acid, 38 lbs. of potash, and 25 lbs. of soda. In other words, these four bodies make up about 83 per cent. of the whole ash.

1000 lbs. of fresh apple contain about 827 lbs. of water, 170.4 lbs. of organic matter, destroyed by heat, and 2.6 lbs. of inorganic matter or ash. 1000 lbs. of dry apple contain between 17 and 18 lbs. of ash.

MEAN OF THE FIVE FOREGOING ANALYSES.

	With carbonic acid.	Without carbonic acid.
Carbonic acid,	15.210	.....
Silica,	1.362	1.637
Phosphate of iron,	1.336	1.593
Phosphoric acid,	11.252	13.267
Lime,	3.442	4.199
Magnesia,	1.400	1.669
Potash,	31.810	37.610
Soda,	20.810	24.799
Chlorine,	1.822	2.169
Sulphuric acid,	6.062	7.229
Organic matter thrown down by nitrate of silver,	4.890	5.828
	99.396	100.000

PROXIMATE ORGANIC ANALYSIS OF THE

	Tolman Sweeting.		*Swaar.*		*Kilham Hill.*	
	1000 parts fresh apple.	1000 parts dry apple.	1000 parts fresh apple.	1000 parts dry apple.	1000 parts fresh apple.	1000 parts dry apple.
Cellular fibre,	33.90	190.620	18.80	126.685	29.90	229.453
Glutinous matter with a little fat and wax,	3.52	19.793	1.18	7.276	1.73	13.276
Dextrine,	28.96	162.890	28.54	192.352	21.72	166.681
Sugar and extract,	99.05	557.178	81.04	546.618	59.30	455.069
Malic acid,	2.50	14.061	3.82	25.737	3.46	26.552
Albumen,	8.97	50.452	13.08	88.125	13.17	101.066
Casein,	0.89	5.006	1.96	13.205	1.03	7.904
Dry matter,	177.79	1000.000	148.42	1000.000	130.31	1000.000
Water,	815.20	.....	847.50	.....	863.13	.....
Loss,	7.01	.....	4.08	.....	6.56	.....
	1000.00	.....	1000.00	.....	1000.000	.....

PROXIMATE ORGANIC ANALYSIS OF THE

	Roxbury Russet.		*English Russet.*		*R. I. Greening.*	
	1000 parts fresh apple.	1000 parts dry apple.	1000 parts fresh apple.	1000 parts dry apple.	1000 parts fresh apple.	1000 parts dry apple.
Cellular fibre,	31.20	173.623	44.78	220.929	33.58	204.000
Glutinous matter with a little wax and fat,	1.70	9.460	2.22	10.952	1.32	8.019
Dextrine,	36.22	201.558	41.11	202.823	32.07	194.888
Sugar and extract,	90.27	502.337	93.46	461.099	76.37	464.061
Malic acid,	3.23	17.975	2.98	14.702	3.04	18.485
Albumen,	15.03	83.639	16.13	79.579	16.37	99.459
Casein,	2.05	11.408	2.01	9.916	1.89	12.088
Dry matter,	179.70	1000.000	202.69	1000.000	164.64	1000.000
Water,	813.45	.....	792.11	.....	828.46	.....
Loss,	6.85	.....	5.20	.....	6.90	.....
	1000.000	.....	1000.000	.....	1000.000	.....

Besides the above mentioned bodies, the apple contains a small quantity of tannic and gallic acids. Of the varieties examined, they were found in larger proportion in the russets than in either of the others. To these acids this fruit owes that peculiar astringency so strikingly developed in some varieties, and easily detected in all, by the taste and by the black color struck through them when cut with a knife, or any instrument made of iron.

Leibig states that starch is found in the unripe apple. I have not been able to detect it in the ripe fruit, except in the Talman Sweet, which gave a very faint blue with iodine.

A small quantity of white wax is found, which is derived mainly from the epidermis, over which it is spread, imparting to it, in many varieties, a smooth greasy feel. A little fatty matter is also present, together with a respectable percentage of gluten. The glutinous matter differs from that of the grains, in being less adhesive when moist, and more granular when dry.

The foregoing analyses were made during the months of March and April. The Tolman Sweeting was somewhat shriveled, and rather past its season; the other varieties were fresh and in good eating order. The Tolman Sweeting, English Russet, and Kilham Hill were furnished by E. P. Prentice, Esq., of Mt. Hope.

MEAN OF THE SIX FOREGOING ANALYSES.

	1000 parts of fresh apple.	1000 parts of dry apple.
Cellular fibre,	32.03	190.879
Glutinous matter with a little fat and wax,	1.94	11.463
Dextrine,	31.44	186.805
Sugar and extract,	83.25	497.627
Malic acid,	3.17	19.585
Albumen,	13.79	83.720

Casein,	1.64	9.921
Dry matter,	167.26	1000.000
Water,	826.64	.....
Loss,	6.10	.....
	1000.000	.....

The ripe apple is rich in sugar and a body analogous to gum, called *dextrine*, which has the same composition as starch, but differs from it in being soluble in cold water, and not colored blue with iodine. It derives its name from the action of its solution on polarized light, it causing the plane of polarization to deviate to the right; hence its name—*dextrine*.

Dextrine and gum should not be confounded with each other. They differ very materially in many respects. The former possesses the property of being converted into grape sugar by sulphuric acid and by diastaste, while the latter does not. Dextrine belongs to the class of bodies which are susceptible of nourishing the animal body. All the starch taken as food is converted into dextrine before it is assimilated by the system. The acids of the stomach possess the property of converting starch into this body.

In the fresh apple, 100 lbs. contain about 3.2 lbs. of fibre; 0.2 of a lb. of gluten, fat and wax; 3.1 lbs. of dextrine; 8.3 lbs. of sugar and extract; 0.3 of a lb. of malic acid; 1.4 lbs. of albumen; 0.16 of a lb. of casein, and 82.66 lbs. of water.

In the dry apple, 100 lbs. contain about 19 lbs. of fibre; 1.1 lbs. of gluten, fat and wax; 18.7 lbs. of dextrine; 49.8 lbs. of sugar and extract; 2 lbs. of malic acid; 8.4 lbs. of albumen, and 1 lb. of casein.

In the fresh potato, 100 lbs. contain about 9.7 lbs. of starch; 5.8 lbs. of fibre; 0.2 of a lb. of gluten; 0.08 of a lb. of fatty matter; $\frac{1}{4}$ of a lb. of albumen; 0.45 of a lb. of casein; 1.27 lbs. of dextrine; 2.64 lbs. of sugar and extract, and 79.7 lbs. of water. In the dry potato, 100 lbs. contain about 48.5 lbs. of starch; 29 lbs. of fibre; 1 lb. of gluten; 0.4 of a lb. of fatty matter; 1.25 lbs. of albumen; 2.25 lbs. of casein; 6.32 lbs. of dextrine; and 13.2 lbs. of sugar and extract.

By comparing the composition of the apple with that of the potato, it will be noticed: First. That the former contains, according to the above analyses, about three per cent more of water than the latter. Second. That dextrine and sugar in the apple take the place of starch, dextrine and sugar in the potato. Of the former, 100 lbs. of good fruit contain of dextrine, sugar and extract 11.4 lbs.; the latter has in the same amount of fresh tubers, 13.61 lbs. of starch, dextrine, sugar and extract. In the dry fruit 100 lbs. contain of dextrine, sugar and extract, 68.5 lbs.; in the same quantity of dry potato there is of starch,

dextrine, sugar and extract, 68.02 bs. The above proximate principles are the main bodies in the apple and potato which go to form fat. In the aggregate amount then of fat producing products it will be seen that the apple and potato do not materially differ. It would be natural, however, to infer that 50 lbs. of dextrine and sugar would, if taken into the system, be more likely to make a greater quantity of fat in a given time, or at least to make the same amount in a shorter period, than an equal weight of starch, for this reason, that the two former bodies, although nearly the same in composition with the latter, yet are physically farther advanced in organization, and hence probably approximate nearer the constitution of fat. If this view be taken, then the apple, if of good quality, may be regarded equally if not more rich in fat producing products than the potato. Thirdly, that the apple is richer in nitrogen compounds than the potato. 100 lbs. of fresh apple contain of albumen 1.38 lbs.; the same amount of fresh potatoe has $\frac{1}{4}$ of a lb. 100 lbs. of dry apple contain 8.37 lbs. of albumen and an equal weight of dry tubers has $1\frac{1}{4}$ lbs. 100 lbs. of fresh fruit contain of casein 0.16 of a lb., and an equal weight of fresh tubers, 0.45 of a lb. 100 lbs. of dry apples have 1 lb. of casein, and the same amount of dry potato contains $2\frac{1}{4}$ lbs. Hence it will be observed that 100 lbs. of fresh apple contain of albumen and casein 1.54 lbs., and the same quantity of fresh potato 0.7 of a lb. 100 lbs. of dry fruit have of albumen and casein 9.37 lbs.. and an equal amount of dry tubers, 3.50 lbs.

From the above it will readily be seen that in albumen the apple is richer than the potato, while in casein the reverse is the case. That the aggregate amount of albumen, casein and gluten in good varieties of the apple is more than double that of the same bodies in the potato; hence the former may be regarded richer than the latter in those bodies which strictly go to nourish the system, or in other words, to form muscle, brain, nerve, and in short assist in building up and sustaining the organic part of all the tissues of the animal body.

The juice of the apple forms what was regarded not long ago, a favorite and almost necessary appendage to the farmer's stock of winter luxuries. It is now, however, looked upon by him with comparative indifference as a beverage, he having found a far better and more profitable use for his apples, that of converting them into fat instead of alcohol. The juice of the apple after being fermented is called cider, and contains much of the nutritive matter of the fruit. Cider contains alcohol, sugar, gum or dextrine, malic acid and the phosphates and sulphates of the alkalies, with a little tannic and gallic acids. The juice before being fermented has in addition to the above ingredients, albumen and casein.

APPENDIX.

For the purpose of comparing the composition of the apple with that of several other kinds of fruit it may not be uninteresting to introduce their proximate organic analyses here in connection with those of the apple. M. Berard has examined the unripe and ripe cherry, the unripe and ripe peach, the ripe pear, and the unripe and ripe gooseberry, and arrived at the following results:

	Peach.		*Pear.*		*Cherry.*		*Gooseberry.*	
	Unripe.	Ripe.	Ripe and fresh.	Kept for some time.	Unripe.	Ripe.	Unripe.	Ripe.
Chlorophyl and coloring matter,	0.04	1.10	0.08	0.01	0.05	.....	0.03	.....
Sugar,	trace.	16.48	6.45	11.52	1.12	18.12	0.52	6.24
Dextrine,	4.10	5.12	3.17	2.07	6.01	3.23	1.36	0.78
Fibre,	3.61	1.86	3.80	2.19	2.44	1.12	8.45	8.01
Albumen,	0.76	0.17	0.08	0.21	0.21	0.57	1.07	0.86
Malic acid,	2.70	1.80	0.11	0.08	1.75	2.01	1.80	2.41
Citric acid,	.....	.....	.....	.....	.....	.....	0.12	0.31
Lime,	trace.	trace.	0.03	0.04	0.14	0.01	0.24	0.29
Water,	89.39	74.87	86.28	83.83	88.28	74.85	86.41	81.10
	100.00	100.40	100.00	99.65	99.00	90.00	100.00	100.00

The grape has not been subjected to a rigid chemical examination. Scheele and Braconnot found in it but one acid, tartaric. M. Berard found in addition to tartaric, malic acid. Besides these two acids he found an odoriferous substance, sugar, gum or dextrine and albumen.